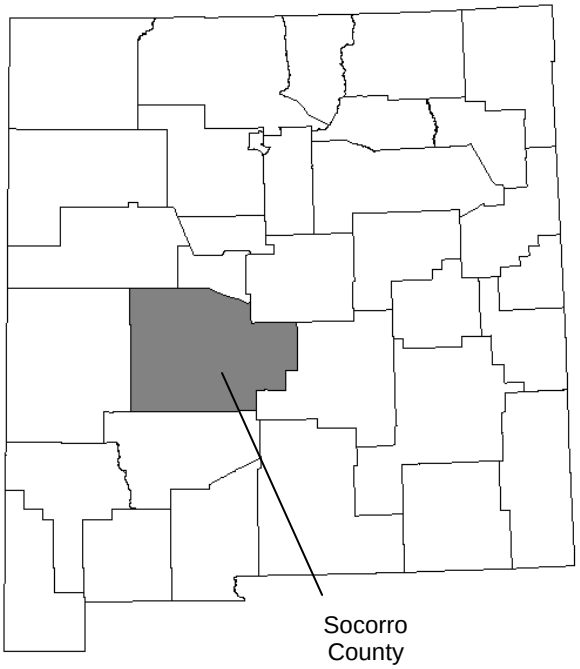
FLOOD INSURANCE STUDY

SOCORRO COUNTY, NEW MEXICO
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
ACOMA, PUEBLO OF	350089
MAGDALENA, VILLAGE OF	350076
NAVAJO NATION	350091
SOCORRO COUNTY (UNINCORPORATED AREAS)	350075
SOCORRO, CITY OF	350077



EFFECTIVE DATE:
MAY 2, 2016

Reprinted with Corrections on April 25, 2016

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
35053CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

Initial Countywide FIS Effective Date: May 2, 2016

This FIS Report was reissued on April 25, 2016 to make a correction; this version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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FLOOD INSURANCE STUDY
SOCORRO COUNTY, NEW MEXICO
AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) report revises and supersedes the FIS reports and/or Flood Insurance Rate maps (FIRMs) in the geographic area of Socorro County, New Mexico, including the City of Socorro, the Village of Magdalena, the Pueblo of Acoma, the Navajo Nation, and the unincorporated areas of Socorro County (hereinafter referred to collectively as Socorro County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Socorro County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

The Navajo Nation is in Bernalillo, Cibola, McKinley, Rio Arriba, San Juan, Sandoval, and Socorro Counties, NM, as well as several counties in Arizona. The Pueblo of Acoma is located in parts of Catron, Cibola, and Socorro Counties, NM. See these separately published FIS reports and Flood Insurance Rate Maps (FIRMs) for the countywide map dates and flood hazard information outside of Socorro County.

In some states and communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State or other jurisdictional agency will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

Information on the authority and acknowledgements for each of the previously printed FISs and Flood Insurance Rate Maps (FIRMs) for communities within Socorro County was compiled, and is shown below.

Socorro, City of: In the May 17, 1988 study (Reference 1), the hydrologic analyses were obtained from a report on the Rio Grande Basin prepared by Espey, Huston, and Associates, Inc., for the Albuquerque District of the U.S. Army Corps of Engineers (USACE). The hydraulic analysis was obtained from a report on the Rio Grande prepared by Ken O'Brien and Associates for the USACE, Albuquerque District.

There are no previous FIS or FIRMs for the Village of Magdalena, the areas of the Pueblo of Acoma and Navajo Nation in Socorro County, or the unincorporated areas of Socorro County.

The previous authority and acknowledgement information for these communities is therefore not included in this FIS.

For this first time countywide FIS, Risk Assessment, Mapping, and Planning Partners (RAMPP) complied existing data into digital format. RAMPP also performed approximately 609.3 miles of new approximate study and 10.4 miles of new detailed study. In addition RAMPP redelineated the existing study of the Rio Grande River using LiDAR. Detailed mapping of "without levee" flooding was conducted for some areas to indicate the extent of the "without levee" floodplains per the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems." Additional guidance is provided by FEMA's "Procedure Memorandum No. 34 – Interim Guidance for Studies Including Levees" (Reference 2), "Procedure Memorandum No. 43 – Guidelines for Identifying Provisionally Accredited Levees" (Reference 3), and "Procedure Memorandum No. 52 – Guidance for Mapping Process Associated with Levee Systems" (Reference 4). RAMPP completed this work in September 2011 under Contract No. HSFEHQ-09-D-0369.

Base map information shown on this FIRM was derived from multiple sources. This information was compiled from the U.S. Geological Survey, 1989 and 1999; National Geodetic Survey, 2004; U.S. Census Bureau, 2006 and 2009; Bureau of Land Management, 2006. Additional data contains 1 meter compressed county mosaic orthoimagery files that were acquired and processed using specifications set by the U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office, National Agriculture Imagery Program (NAIP) 2009.

The projection used in the preparation of this map was New Mexico State Plane, Central Zone (FIPS 3002). The horizontal datum was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM. Flood elevations on this map are referenced to the North American Vertical Datum of 1988.

1.3 Coordination

The initial Consultation Coordination Officer's (CCO) meeting was held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. The final CCO meeting was held with representatives from FEMA, the community and the study contractor to review the results of the study. All problems raised in the meeting have been addressed in this study.

The following dates are the pre-countywide initial and final CCO meetings held for the City Socorro. On October 16, 1986, the City of Socorro was informed by FEMA of the initiation of a FIS for the community. On June 16, 1987, the results of the study were reviewed at a final CCO meeting.

For this countywide FIS, an initial CCO meeting was held on November 3, 2009, and was attended by representatives of the community, the study contractor, and FEMA. The final CCO meeting was held on November 30, 2011, and was attended by representatives of the community, the study contractor, and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Socorro County, New Mexico, including the incorporated communities listed in Section 1.1. Table 1, "Streams Studied by Detailed Methods," lists the

streams that were studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction.

Table 1: Streams Studied by Detailed Methods

Stream	Limits of Detailed Study
Arroyo A	City Limits of the City of Socorro
Arroyo B	City Limits of the City of Socorro
Arroyo D	City Limits of the City of Socorro
Arroyo E	City Limits of the City of Socorro
Arroyo F	City Limits of the City of Socorro
Arroyo G	City Limits of the City of Socorro
Arroyo H	City Limits of the City of Socorro
Rio Grande	Upstream: 1,450 feet north of City Limits of the City of Socorro Downstream: 80 feet south of City Limits of the City of Socorro
Unnamed Stream 44	City Limits of the City of Socorro

Numerous flooding sources were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flooding hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and the communities.

No Letters of Map Change were found in Socorro County and, therefore, have not been incorporated into the mapping of this countywide study.

2.2 Community Description

Socorro County is located in west-central New Mexico, and is bordered on the northeast by Valencia County, on the northwest by Cibola County, on the east by Torrance and Lincoln Counties, on the south by Sierra County, and on the west by Catron County. In 2009, the estimated population of Socorro County was 18,092 (Reference 5).

Socorro County has a mild, semiarid, continental climate that is characterized by light precipitation, abundant sunshine, and low relative humidity. The average annual precipitation is 10.22 inches (Reference 6).

The county seat of Socorro County is the City of Socorro. The estimated population of Socorro in 2009 was 8,924 (Reference 5). The City of Socorro is located in the Rio Grande Valley near the center of the county. It is situated along the Rio Grande and is bounded to the west by the Magdalena Mountains.

The Village of Magdalena is located approximately 30 miles west of the City of Socorro. It is located in a valley in the Magdalena Mountains. The estimated population of Magdalena in 2009 was 964 (Reference 5).

2.3 Principal Flood Problems

In the City of Socorro, on August 12, 1929, the Rio Grande valley between San Acacia and San Marcial was flooded. This flood was the result of a general storm that occurred August 8-11, 1929, in southern Colorado and northern and western New Mexico. During this period, much of the area received over 2 inches of precipitation. The heaviest rainfall centered over the Rio Chama, Rio Puerco, and Rio Salado watersheds, as well as the side arroyo drainage areas in the vicinity of Socorro.

On July 6, 1998, a flash flood resulted from heavy rain in Alamo. Nearly 100 families were forced to take a 15 mile detour as a result of a major road being washed out. There was estimated $50,000 damage as a result of this storm. Another storm that same month on July 23 washed out many of the repairs to the same road, causing another $10,000 damages. A storm on July 17, 1998 in the City of Socorro resulted in $5,000 damages when several small arroyos filled with debris, overflowed, and caused damage to several homes.

Heavy rain fell in Socorro on July 21, 1999. The runoff from the Magdalena Mountains caused the levees along the Arroyo de la Matanza to fail. Water flooded nearly 800 acres of farmland washing away fresh cut alfalfa hay and covering about 300 acres in heavy mud. An adjacent railroad bed was also undercut least 5 times along 2 miles of track. There was approximately $150,000 in damages.

Heavy rains fell throughout the summer of 2006. 2 to 3 inches per hour fell in July 28, 2006, overtaking the arroyos and irrigation channel throughout Socorro County, and causing $240,000 in property and crop damages. Levees and canals were overtopped, and fields were heavily damaged. Repeat rains in the next several days interfered with cleanup and repairs.

A flash flood occurred in the Village of Magdalena on July 23, 2010. A landslide washed out a dirt road, causing $10,000 in damages.

2.4 Flood Protection Measures

Some flood hazard information presented in prior FIRMs and in prior FIS reports for Socorro County and its incorporated communities was based on flood protection provided by levees. Based on the information available and the mapping standards of the NFIP at the time that the prior FIS and FIRMs were prepared, FEMA accredited the levees as providing protection from the flood that has a 1-percent chance of being equaled or exceeded in any given year. For FEMA to continue to accredit the identified levees with providing protection from the base flood, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

The 1988 study for the City of Socorro assumes that levees or barriers formed by railroads, highways, and irrigation canals would not fail. All other levees were assumed to fail or be ineffective when the water level was 2 feet or less from the top. Additionally, specific points on the Rio Grande levees were assumed to become ineffective for flows greater than the 10-percent-annual-chance event, approximately 13,500 cubic feet per second (cfs).

These levees may not protect the community from rare events such as the 1-percent-annual-chance flood. The criteria used to evaluate protection against the 1-percent-annual-chance flood are: 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 1-percent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain.

It should be noted that in 2015, the USACE began rebuilding sections of the Rio Grande Levees around the City of Socorro to meet FEMA's requirements for flood protection outlined in 44 CFR 65.10

The Socorro Diversion Channel Levee System, which includes the Socorro Diversion Channel, and Matanza Levee, was accredited by FEMA in June 2015. This levee system meets the minimum requirements outlined in 44 CFR 65.10.

Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annnual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection in Socorro County. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and flood proofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/national-flood-insurance-program.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent-annual-chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance (100-year) flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Peak discharge-drainage area relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for each stream studied by detailed methods are presented in Table 2 – Summary of Discharges.

Pre-Countywide Analysis:

The hydrologic analysis for the May 17, 1988, City of Socorro study was obtained from the report Rio Grande Basin, New Mexico, Rio Puerco, and Rio Salado Watersheds, Design Memorandum No. 1, Part 1, Hydrology (Reference 7)

Countywide Study (May 2, 2016):

This countywide study includes streams studied by approximate methods, redelineation of the portions of the Rio Grande, and detailed analysis of the shallow flooding within the City of Socorro. The shallow flooding analysis of the City of Socorro considered conditions with and without the Socorro and Matanza Levees.

Table 2: Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
RIO GRANDE					
At the downstream corporate limits of the City of Socorro	27,000	*	34,000	46,000	*
ARROYO A					
Above Levee[1]	2.91	189	517	724	1,367
ARROYO B					
Above Levee[1]	3.39	466	1,147	1,557	2,791
Additional Below Levee[2]	0.16	6	40	64	147
ARROYO D					
Above Levee[1]	1.40	160	400	546	986
Additional Below Levee[2]	0.19	16	41	56	104
ARROYO E					
Above Levee[1]	1.20	84	266	384	756
Additional Below Levee[2]	0.91	133	312	419	738
ARROYO F					
Above Levee[1]	1.93	172	419	567	1,011
Additional Below Levee[2]	0.24	24	62	85	155

[1] Above levee refers to flood discharge generated in the portion of the contributory watershed not protected by the Socorro Diversion Channel Levee. A discharge hydrograph was input into a 2-dimensional unsteady hydraulic model.
[2] Additional Below Levee refers to flood discharge generated in the portion of the contributory watershed protected by the Socorro Diversion Channel Levee. A discharge hydrograph was input into a 2-dimensional unsteady hydraulic model.
* Data Not Available

Table 2: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
ARROYO G					
Above Levee[1]	4.90	1,629	3,087	3,865	6,075
ARROYO H					
Above Levee[1]	0.33	14	48	70	142
Additional Below Levee[2]	0.56	146	290	371	601
UNNAMED STREAM 44					
Above Levee[1]	1.12	46	144	208	411
Additional Below Levee[2]	0.20	12	39	57	115
SHEET FLOW BETWEEN ARROYO B AND D					
Above Levee[1]	0.29	18	60	88	177
Additional Below Levee[2]	0.51	77	171	225	386
SHEET FLOW BETWEEN ARROYO H AND E					
Above Levee[1]	0.36	24	76	110	216
Additional Below Levee[2]	0.61	81	210	289	528

[1] Above Levee refers to flood discharge generated in the portion of the contributory watershed not protected by the Socorro Diversion Channel Levee. A discharge hydrograph was input into a 2-dimensional unsteady hydraulic model.
[2] Additional Below Levee refers to flood discharge generated in the portion of the contributory watershed protected by the Socorro Diversion Channel Levee. A discharge hydrograph was input into a 2-dimensional unsteady hydraulic model.

LiDAR and orthographic data obtained for this study (References 8 and 9) were used in conjunction with U.S. Geological Survey (USGS) Digital Elevation Model (DEM) (Reference 10) data to create a terrain model of Socorro County. The terrain model was used to delineate drainage basins and other watershed characteristics.

For the approximate analysis, the peak 1-percent-annual-chance discharge values for the Rio Grande, La Jencia Creek, Rio Puerco, and Rio Salado were determined using USGS stream gage data and the PeakFQ software (Reference 11). For all other streams studied by approximate methods, the 1-percent-annual-chance discharge values were determined using the USGS 2008 regional regression equations for the New Mexico Central Mountain Valley Region, Region 6 (Reference 12).

The National Flood Frequency (NFF) Program, Version 3.2 (Reference 13), was used for computation of the 10-, 2-, 1-, and 0.2-percent-annual-chance storm event discharge values. The NFF program uses regional regression equations based on physiography, elevation, and precipitation. New Mexico is divided into eight such hydrologic regions, with Socorro County falling within the Central Mountain Valley Region. In addition, the NFF software extrapolates the 500-year event flow rate from the flow rates calculated for the other storm events. No weighting estimates can be performed on the study reaches due to the lack of available gage data.

The detailed analysis of the shallow flooding in the City of Socorro required that input hydrographs be computed rather than the peak discharge determined by NFF. Rainfall-runoff modeling was therefore required. The Corps of Engineers Hydrologic Engineering Center - Hydrologic Modeling System (HEC-HMS) rainfall runoff model (Reference 14) was used to compute the 10-, 2-, 1-, and 0.2-percent-annual-chance discharges for the watersheds contributory to the City of Socorro and the City of Socorro flood protection system (Socorro Diversion Channel and Matanza Levees). HEC-HMS required watershed information such as basin area, land use, soil type and a rainfall hyetograph.

Watershed characteristics, such as sub-basin area and cumulative basin area, were obtained through field investigation, available topographic data, and available orthophotogrammetric data.

The centroid of the watershed contributory to the City of Socorro was approximated based on the watershed delineation. The coordinates of the centroid were input into the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 website (Reference 15). The NOAA Atlas website uses the coordinates of a fixed location to interpolate the average precipitation values for that location. Updated Precipitation Frequency Data for the state of New Mexico were released by NOAA in August 2003. These data supersede NOAA Atlas 2 data. This rainfall depth was used to compute an SCS (Soil Conservation Service) Type II-75 hyetograph (Type II modified for New Mexico). An area reduction factor in accordance with TP-40 (Reference 16) was applied to the total rainfall depth based on the entire contributory area. The hyetograph was incorporated into the HEC-HMS model.

Rainfall loss and hydrograph transformation as incorporated in the model using the methods outlined in the SCS Technical Release 55 (Reference 17). The hydrograph transformation is based on dividing the watershed flow path into sheet flow segments, shallow concentrated flow segments, and channel flow segments and computing the flow travel time through each segment. The rainfall loss is dependent on land use and hydrologic soil group. The land use was determined using the National Land Cover Data and the New Mexico Land Cover Key (Reference 18). The hydrologic soil group was determined from information obtained using the Soil Survey Geographic (SSURGO) published in2008 obtained from the US Department of Agriculture Geospatial Data Gateway (Reference 19). This SSURGO information supplemented with SSURGO information published in 2006 for the areas of the Magdalena Mountains obtained

from the Natural Resources Conservation Service (NRCS) web soil survey website (Reference 20).

The peak discharge values developed for the shallow flooding analysis using the HEC-HMS model are listed in Table 2. The Table lists the peak discharge values Above Levee and Additional Below Levee. The Above Levee refers to the peak flood discharge for the contributory watershed not protected by the levee. The Additional Below Levee refers to the peak discharge generated from the portion of the watershed protected by the levee. The hydrographs for each location were inputted into a two-dimensional unsteady hydraulic model.

The Stillwater elevations have been determined for the 1-percent annual chance floods in the City of Socorro in static flooding zones, wherever lacustrine flooding was determined to exist. The locations and elevations of the static flood zones are summarized in Table 3, "Summary of Stillwater Elevations."

Table 3: Summary of Stillwater Elevations

Area	Water Surface Elevations (feet NAVD[1]) 1-Percent-Annual-Chance
Northeast of intersection of Lopezville Rd and Newberry Rd	4,616

[1] North American Vertical Datum of 1988

3.2 Hydraulic Analysis

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed, selected cross-section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Pre-Countywide Analysis:

The hydraulic analysis for the May 17, 1988, City of Socorro study was obtained from the report Additional Hydraulic Study for Reaches of the Rio Grande (Reference 21).

Flooding sources with a pre-countywide detailed study and that were not restudied for the initial countywide FIRM underwent a redelineation process, which in this case consisted of converting the flood profiles to the North American Vertical Datum 1988 (also in NAVD88) and updating

the floodplain boundaries based on the most current topographic data (also in NAVD88). New hydrologic and hydraulic analyses were not performed on the redelineated flooding sources.

Countywide Study (May 2, 2016):

Detailed hydraulic analyses within the City of Socorro were conducted using FLO-2D (Reference 22). The elevations developed for the two-dimensional mesh were developed directly from data points obtained by LiDAR. Blockage and volume reduction of buildings was accounted for in the model. Overland flow blockage by Interstate 25 and the railroad were accounted for in the model. In addition, conveyance features such as streets, channels and culverts were accounted for in the model. Roughness coefficients were estimated based on aerial photography and recommendations of the within the FLO-2D documentation. Table 4 "Summary of Roughness Coefficients" provides the roughness coefficients used in the FLO-2D model.

Table 4: Summary of Roughness Coefficients

Element	Manning's n-value
Floodplain	0.09 - 0.178
Channel	0.065 - 0.130
Street	0.04

Some flood hazard information presented in prior FIRMs and in prior FIS reports for Socorro County and its incorporated communities was based on flood protection provided by levees. Based on the information available and the mapping standards of the NFIP at the time that the prior FIS and FIRMs were prepared, FEMA accredited the levees as providing protection from the flood that has a 1-percent chance of being equaled or exceeded in any given year. For FEMA to continue to accredit the identified levees with providing protection from the base flood, the levees must meet the criteria of 44 CFR 65.10, titled "Mapping of Areas Protected by Levee Systems."

FEMA coordinated with the USACE, the local communities, and other organizations to compile a list of levees that exist within Socorro County. Table 5 lists all levees previously shown on an effective FIRM, to include PALs, for which corresponding flood hazard revisions were made.

On April 24, 2009 FEMA issued Procedure Memorandum No. 52 – Guidance for Mapping Processes Associated with Levee Systems. This memorandum provides guidelines for mapping landward of levee systems. Detailed analyses of "behind levee" flooding were conducted for all the levees in Table 5 to indicate the extent of the "behind levee" floodplains in accordance with Procedure Memorandum No 52.

The detailed hydraulic analysis was conducted using FLO-2D software for several "without levee" scenarios with regard to the Socorro Diversion Channel Levee System which includes the Socorro Diversion Channel Levee, and the Matanza Levee. This levee system is constructed west and north of the City of Socorro. Portions of the "behind levee" floodplains are therefore shown as being protected from the 1-percent-annual-chance flood by a levee system that is accredited.

Table 5: List of Accredited Levees.

Community	Flood Source	Levee	USACE Levee	Status
City of Socorro and Socorro County	Socorro Diversion Channel	Socorro Diversion Chanel Levee	Yes	Accredited
City of Socorro and Socorro County	Matanza Arroyo	Matanza Levee	Yes	Accredited

Approximate hydraulic analyses were conducted using GEOFIRM (Reference 23) and HEC-RAS (Reference 24). Cross-section geometries for approximate models were obtained from digital terrain data created in GEOFIRM. A channel Manning's n value of 0.04 and an overbank Manning's n value of 0.05 was used for the approximate hydraulic analysis. All models were run at sub-critical depth per FEMA's Guidelines and Specifications (Reference 25). Downstream boundary conditions were set to normal depth and calculated for all streams. The minimum starting slope of 0.001 ft/ft was used. Along certain portions of the Rio Grande, a profile base line is shown on the maps to represent channel distances as indicated on the flood profiles.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. Some of the data used in this study were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD88. The datum conversion factor from NGVD29 to NAVD88 in Socorro County is +2.265 feet.

For additional information regarding conversion between the NGVD29 and NAVD88, visit the National Geodetic Survey website at http://www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data table, and Summary of Stillwater Elevations table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

Pre-Countywide Analysis:

Within the City of Socorro along the Rio Grande, between cross sections, the boundaries were originally interpolated using topographic maps at a scale of 1:4,800 with a contour interval of 5 feet (Reference 26).

Countywide Study (May 2, 2016):

Detailed study floodplain boundaries for the shallow flooding analysis within the City of Socorro were delineated using LiDAR. Approximate floodplain boundaries were determined using USGS DEMs.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and AO), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-

chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

Along streams where floodways have not been computed, the community must ensure that the cumulative effect of development in the floodplains will not cause more than a 1.0-foot increase in the BFEs at any point within the county.

No floodways have been calculated within Socorro County.

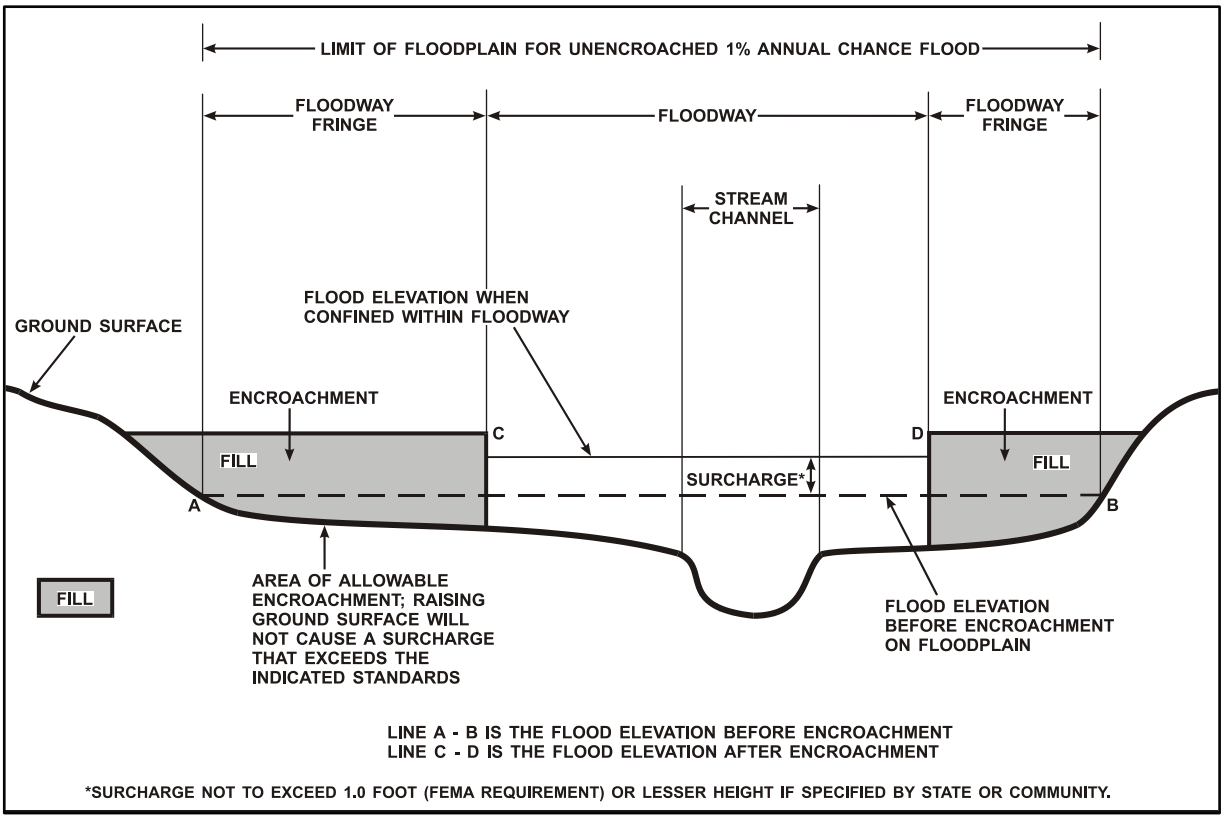

Figure 1: Floodway Schematic

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations (BFEs) or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by detailed methods. In most instances, whole foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or depths are shown within this zone.

Zone D

Zone D is the flood insurance risk zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance risk zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of Socorro County. Prior to countywide mapping, separate FIRMs were prepared for each identified flood-prone incorporated community and for the unincorporated areas of the county. Historical data

relating to the pre-countywide FIRMs for each community are presented in Table 6, "Community Map History."

7.0 OTHER STUDIES

This FIS report is compatible with FISs that have been prepared for communities surrounding Socorro County (References 27 - 32). Flood and floodway data present are in agreement with the effective FIS for Cibola, Lincoln, and Valencia Counties, New Mexico.

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Socorro County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FHBMs, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Socorro County (References 1 & 32).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting:

FEMA, Federal Insurance and Mitigation Division
Federal Regional Center
800 North Loop 288
Denton, Texas 76209-3698

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Pueblo of Acoma[1]	N/A	None		
Magdalena, Village of[2]	August 2, 1974	February 20, 1976		
Navajo Nation[1]	N/A	None		
Socorro, City of	June 28, 1974	January 16, 1976	May 17, 1988	
Socorro County [2] (Unincorporated Areas)	N/A	None		

[1] This community did not have a FIRM prior to the first countywide FIRM for Cibola County, New Mexico
[2] This community did not have a FIRM prior to the first countywide FIRM for Socorro County, New Mexico

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

SOCORRO COUNTY, NM

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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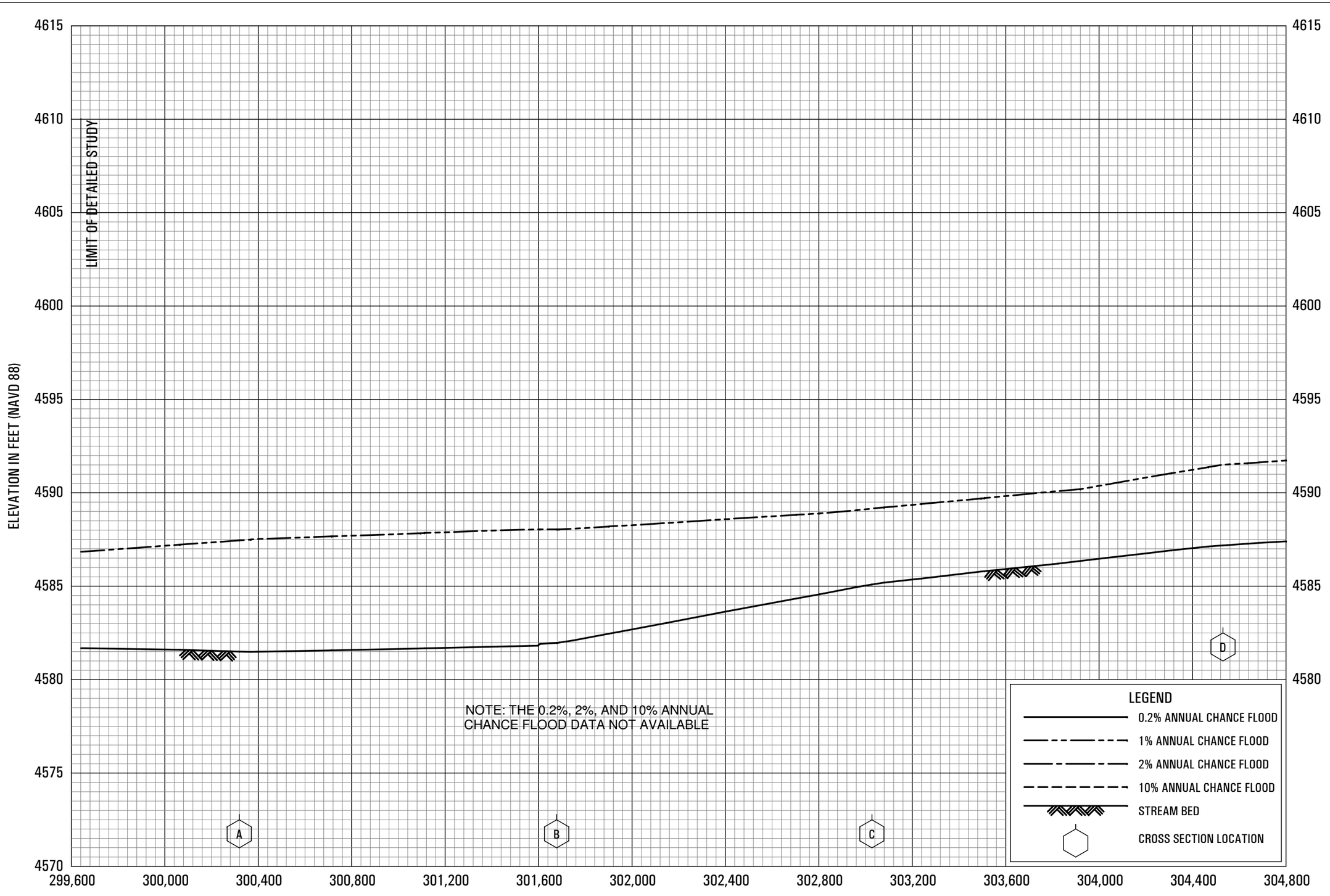

FLOOD PROFILES

RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

SOCORRO COUNTY, NM

AND INCORPORATED AREAS

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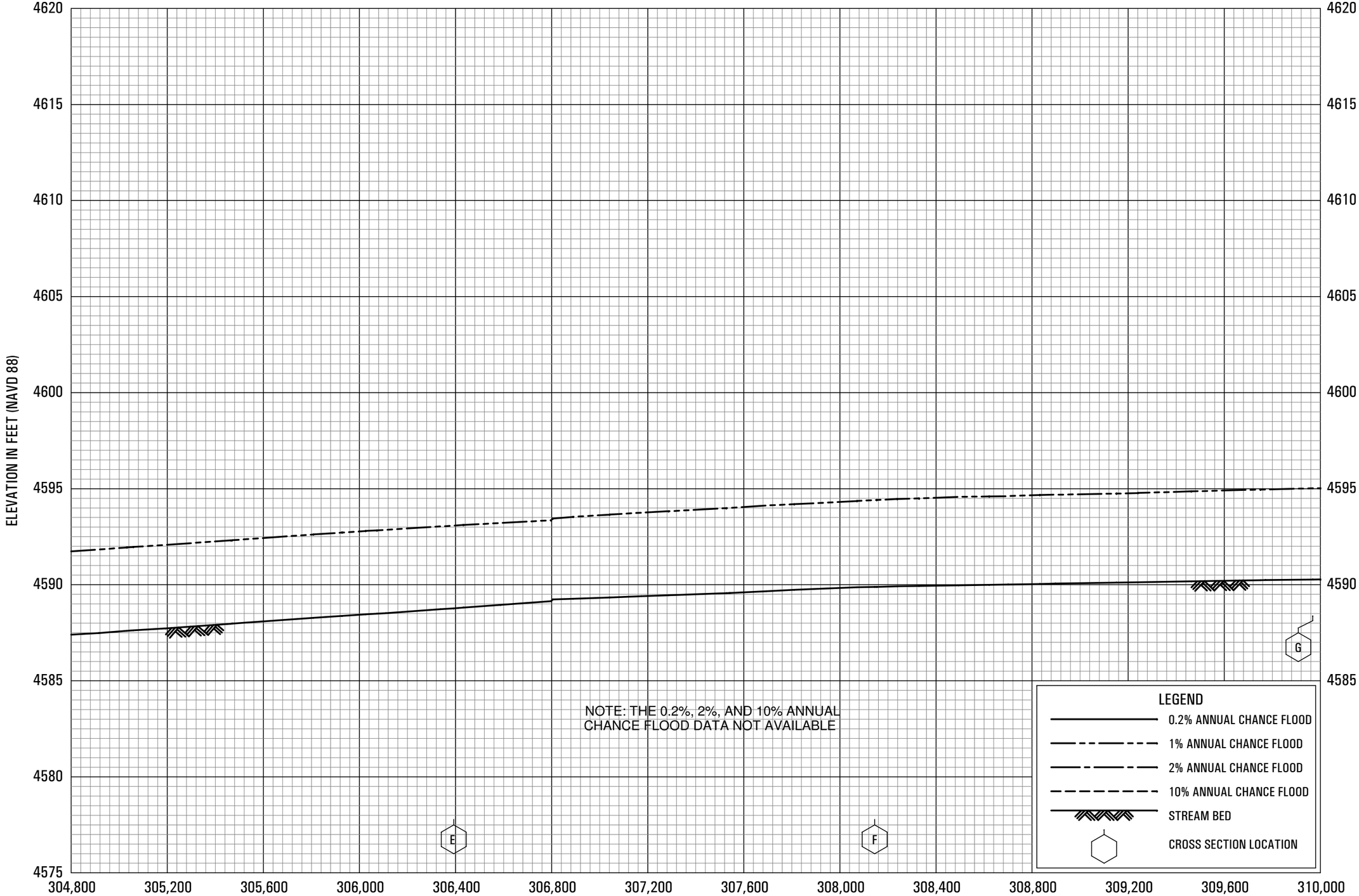

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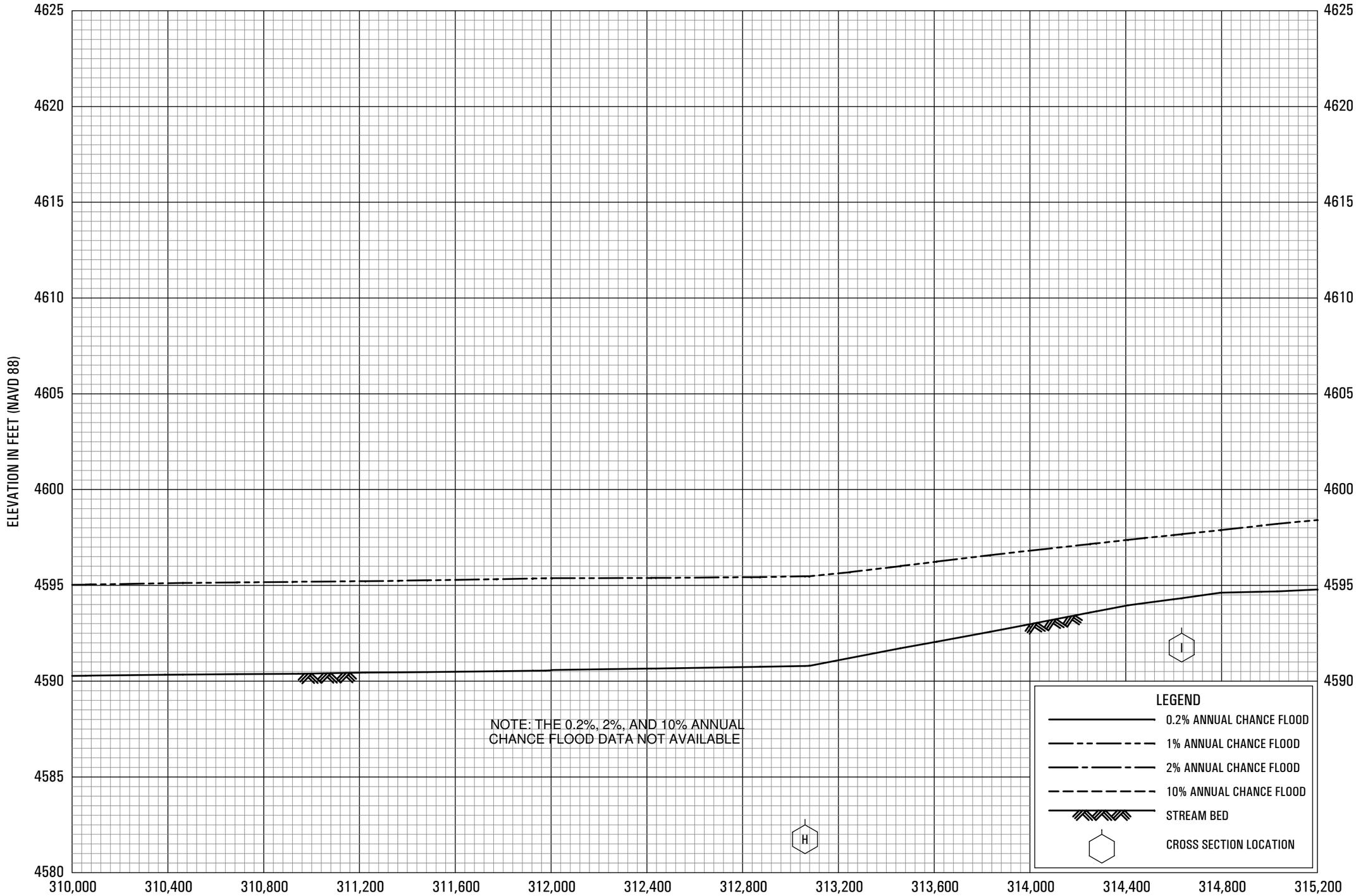

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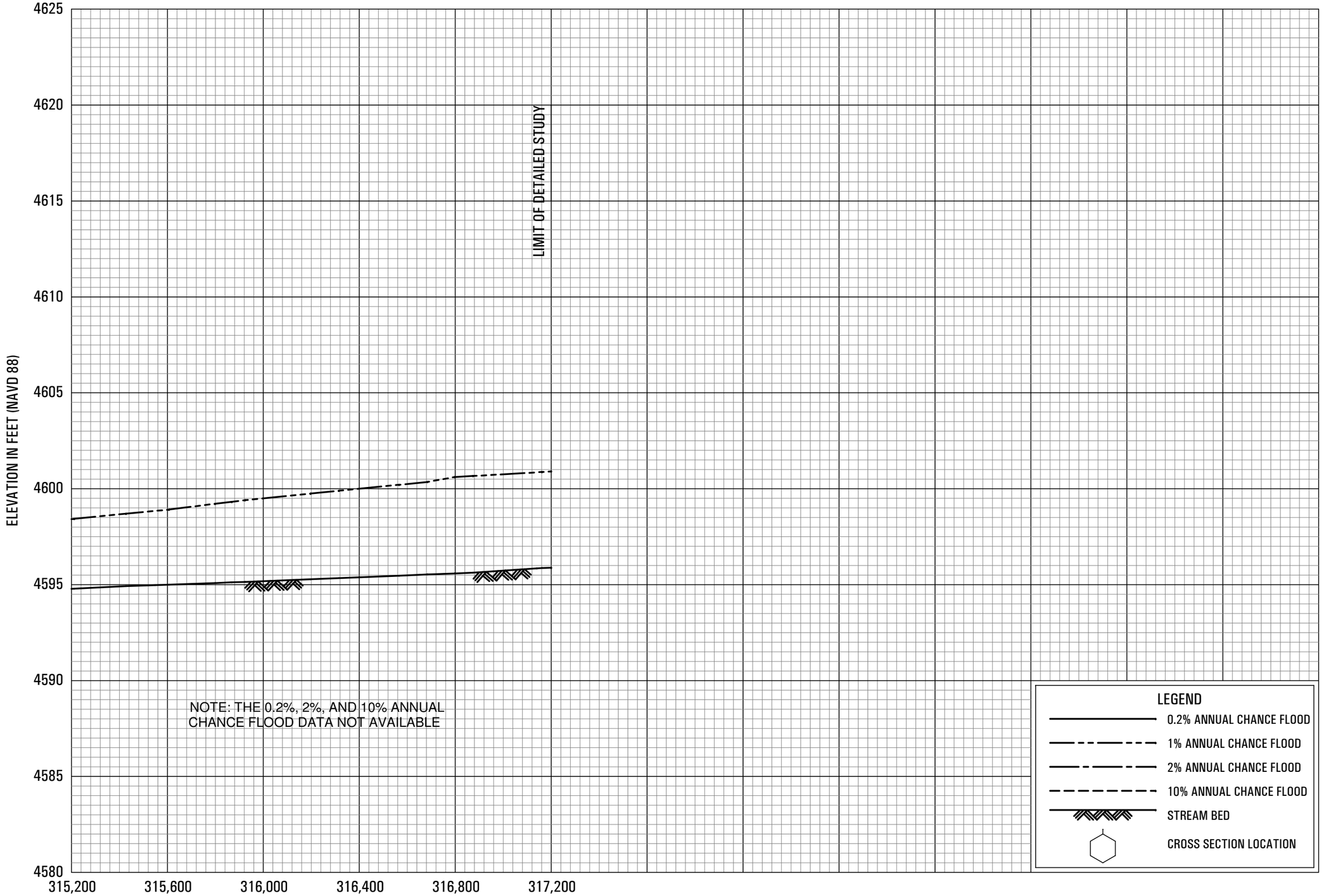

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